TERRA (EOS AM 1)

PROJECT HIGHLIGHTS

Announcement of Opportunity	AO-OSSA-1-88
NASA Headquarters Office	Earth Science (Code Y)
Enterprise	Earth Science
Project	TERRA Earth Observing System AM 1
Project Lead Center	GSFC
Management Approach	Out-of-House
Mission Life months	60 (minimum) 90 (fuel)
Additional Data Analysis (months)	N/A
Launch Date	18 Dec 1999

MISSION OBJECTIVES

The TERRA (EOS AM 1) primary objective is to provide a multidisciplinary study of the Earth's interrelated processes (atmosphere, oceans and land-surface) and their relationship to Earth system changes. The global change research from TERRA (EOS AM 1) instrument data sets includes cloud physics and atmospheric radiation properties in addition to terrestrial and oceanic surface characteristics.

FOREIGN PARTICIPATION

Canada: Measurement of Pollution in the Troposphere (MOPITT)

Japan: Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

Various: Team Members on Facility instruments

SPACECRAFT DESCRIPTION

The TERRA (EOS AM 1) spacecraft is constructed with a truss-like primary structure built of graphite-epoxy tubular members. This lightweight structure provides the strength and stiffness needed to support the spacecraft throughout its various mission phases The zenith face of the spacecraft is populated with equipment modules (EMs) housing the various spacecraft bus components The EMs are sized and partitioned to facilitate pre-launch integration and test of the spacecraft. A large single-wing solar array is deployed on the sunlit side of the spacecraft Locating the array on this side maximizes both its power generation capability and the cold-space field-of-view available to instrument and equipment module radiators A steerable high-gain antenna and associated electronics are mounted on a deployed boom extending from the zenith side of the spacecraft This location maximizes the amount of time available for TDRSS communications via this antenna without obstruction by other pads of the spacecraft The instruments are mounted on the nadir-pointed side of the spacecraft in order to provide the appropriate optical and thermal fields-of-view for the instrument police and radiators.

<u>PAYLOAD DESCRIPTION</u>

TERRA (EOS AM 1) carries five instruments. The payload overall objectives are to measure clouds, aerosols and radiation balance; characterize the ecosystem; monitor land use, soils and tropospheric chemical composition; assess the contribution of volcanoes to climate; and measure ocean primary productivity. The payload consists of two facility instruments and three Principal Investigator (PI) instruments.

<u>INSTRUMENT DESCRIPTIONS AND SCIENCE LEADERS</u>

Data Point Number 863: The Advanced Spaceborne Thermal Emission and Reflection Radiometer instrument (ASTER) [protoflight] (TERRA EOS AM 1) is a facility instrument that provides high resolution multispectral imaging over 14 bands in the visible and thermal infrared regions. It includes three separate radiometers operating in the visible and near infrared region, short wavelength infrared region and thermal infrared region. The instrument also Includes a common signal processor and a multiprocessing simulator. H. Tsu (Japan Geological Survey) is the instrument PI.

Data Point Number 864: The Clouds and the Earth's Radiant Energy System instrument (CERES) [protoflight] (TERRA EOS AM 1) is a scanning radiometer with three telescope units. The bolometer detectors sense in the total reflectance, shortwave and longwave spectral regions. TERRA (EOS AM 1) carries two identical CERES broadband scanning radiometers. One of these operates in the crosstrack mode for limb-to-limb spatial coverage. The other operates with a rotating scan plane to provide angular sampling. Bruce Barkstrom (LaRC) is the instrument PI.

Data Point Number 865: The Multi-Angle Imaging Spectro-Radiometer instrument (MISR) [protoflight] (TERRA EOS AM 1) is a pushbroom imager with nine charge-coupled device (CCD)-based cameras looking forward, nadir, and aft along the spacecraft ground path. The instrument acquires global multispectral imagery at nine viewing angles to measure the abundance and properties of tropospheric aerosols, thus providing important information for assessing the global impact of aerosols on the Earth's shortwave radiation budget. David Diner (JPL) is the instrument PI.

Data Point Number 866: The Moderate Resolution Imaging Spectroradiometer instrument (MODIS) [photoflight] (TERRA EOS AM 1) is a facility instrument that scans a crosstrack swath 2,330 km wide and senses 36 spectral bands. The instrument is designed to conduct long-term observation of the Earth in order to develop an improved understanding of global dynamics and processes occurring on the surface and in the lower atmosphere. V. Salomonson (GSFC) is the instrument PI.

Data Point Number 867: The Measurement of Pollution in the Troposphere Instrument (MOPITT) [protoflight] (TERRA EOS AM 1) makes use of the principle of correlation spectroscopy whereby a cell of the gas to be measured is used as an optical filter in the infrared to measure the signal from the same gas in the atmosphere. The amount of gas in the instrument is modulated by varying either the pressure or the length. In addition to the correlation technique, MOPITT makes use of mechanically cooled detectors and filters (at 100 degrees Kelvin) to enhance the overall performance. The use of this cooling technique, which relies on Stirling Cycle coolers, is relatively new in satellite instrumentation having been used previously on only two civilian satellite instruments. The use of mechanical cooling rather than stored cryogen or radiative cooling permits a relatively large amount of cooling - sufficient for both the detectors and the filter system - while still permitting a five year instrument life. J. R. Drummond (University of Toronto) is the instrument PI.

GROUND SYSTEM DESCRIPTION

TERRA (COS AM 1) utilizes TDRSS for return link transmission of recorded science and engineering data, for transmission of realtime engineering and housekeeping data and for receiving realtime commands and spacecraft loads for handling by the spacecraft on-board computer. The spacecraft provides a Direct Access System (DAS) that allows ASTER and MODIS data to be provided to various user ground stations via X-band. The EOSDIS, which serves as NASA's Earth science data system for information management, archiving and distribution, provides data processing product generation, data archiving and data distribution services for TERRA (EOS AM 1) Ground Network (GN) stations and other ground stations provide contingency and emergency command and telemetry support on the spacecraft S-band link in the event of a loss of TDRSS service.

Other ground system elements not shown in the above ground system diagram include the EOS Operations Center (EOC), the EOS Data and Operations System (EDOS), EOS Backbone Network (EBNET) and the Flight Dynamics Facility (FDF). The EOC provides mission planning and scheduling functions, instrument operations support and overall spacecraft operations management. All command uplink operations for the spacecraft will be performed by the EOC. EDOS receives forward link data from the EOC for routing to the spacecraft and provides realtime services and production (Level Zero) processing (packet time order sequencing, data transmission artifact removal and quality checking). EBNET provides the primary communications network for transport of NASA mission critical data from the EOC to the TDRSS and science and engineering data from the TDRSS to the EOSDIS and other facilities requiring Level Zero data. The FDF provides orbit determination support and altitude determination and control support for TERRA (EOS AM 1).

CONTRACT AND SUBCONTRACT HISTORY

Contractor/Subcontractor	Project Element
Lockheed Martin	Spacecraft
TRW	CERES
JPL	MISR
SBRC	MODIS
Draper Labs	Systems Analysis

LAUNCH AND MISSION ORBIT DATA

Launch Vehicle/Upper Stage	Atlas II-AS	Inclination (deg)	98
Launch Site	Western Test Range	Period (min)	100
Mission Orbit Type	Sun synchronous polar	Apogee (km)	708
		Perigee(km)	705